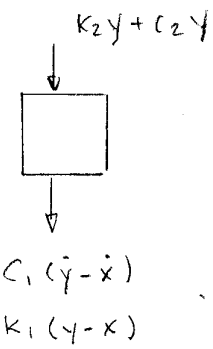
Pneumatic Hammer

(a)



$$\sum F = -(k_2 y + c_2 \dot{y}) - c_1(\dot{y}-\dot{x}) - k_1(y-x) = m\ddot{y}$$

OR

$$m\ddot{y} + (c_1+c_2)\dot{y} + (k_1+k_2)y = k_1 x + c_1 \dot{x} \qquad (1)$$

(b) from (1)

$$G(\omega) = \frac{Y(\omega)}{X(\omega)} = \frac{k_1 + j c_1 \omega}{-m\omega^2 + (k_1+k_2) + j\omega(c_1+c_2)}$$

$$\omega_n = \sqrt{\frac{k_1+k_2}{m}}, \qquad \zeta = \frac{c_1+c_2}{2m\omega_n}$$

and $f = k_2 y + c_2 \dot{y}$

Hence

$$G_1(\omega) = \frac{F(\omega)}{X(\omega)} = \frac{(k_2 + j c_2 \omega)(k_1 + j c_1 \omega)}{-m\omega^2 + (k_1+k_2) + j\omega(c_1+c_2)}$$

$$\omega_n = \sqrt{\frac{k_1+k_2}{m}}$$

Choose $\omega_n \ll \frac{2\pi}{T}$ so that the resonance will not get excited.